



[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2015-4279; Notice No. 25-15-09-SC]

**Special Conditions: Gulfstream Aerospace Corporation, Gulfstream GVI Airplane;
Non-Rechargeable Lithium Battery Installations**

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed special conditions.

SUMMARY: This action proposes special conditions for the Gulfstream Aerospace Corporation GVI airplane. This airplane will have a novel or unusual design feature when compared to the state of technology envisioned in the airworthiness standards for transport-category airplanes. This design feature is non-rechargeable lithium battery systems. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: Send your comments on or before **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: Send comments identified by docket number FAA-2015-4279 using any of the following methods:

- *Federal eRegulations Portal:* Go to <http://www.regulations.gov/> and follow the online instructions for sending your comments electronically.

- *Mail:* Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, DC, 20590-0001.
- *Hand Delivery or Courier:* Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to <http://www.regulations.gov/>, including any personal information the commenter provides. Using the search function of the docket Web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov/>.

Docket: Background documents or comments received may be read at <http://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Nazih Khaouly, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601

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SUPPLEMENTARY INFORMATION

Comments Invited

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive by the closing date for comments. We may change these special conditions based on the comments we receive.

Background

Gulfstream Aerospace Corporation applied for several changes to Type Certificate No. T00015AT to install non-rechargeable lithium batteries in the Model GVI airplane. The Gulfstream Model GVI airplane is a twin-engine, transport-category airplane with a maximum passenger capacity of 19 and maximum takeoff weight of 99,600 pounds.

Type Certification Basis

Under the provisions of Title 14, Code of Federal Regulations, (14 CFR) 21.101, Gulfstream must show that the design change and areas affected by the change continue to meet the applicable provisions of the regulations listed in Type Certificate No. T00015AT, or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA. The regulations listed in the type certificate are commonly referred to as the “original type certification basis.” The regulations listed in Type Certificate No. T00015AT are 14 CFR part 25 effective February 1, 1965 including Amendments 25-1 through 25-120, 25-122, 25-124, and 25-132. The certification basis also

includes certain special conditions, exemptions, and equivalent safety findings that are not relevant to these proposed special conditions.

In addition to the applicable airworthiness regulations and special conditions, the Gulfstream Model GVI airplane must comply with the fuel-vent and exhaust-emission requirements of 14 CFR part 34, and the noise-certification requirements of 14 CFR part 36.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Gulfstream Model GIV airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the Gulfstream Model GVI airplane model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, these special conditions would also apply to the other model under § 21.101.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.101.

Novel or Unusual Design Features

A battery system consists of the battery and any protective, monitoring and alerting circuitry or hardware inside or outside of the battery and venting capability where necessary. For the purpose of these special conditions, we refer to a battery and battery system as a battery. The Gulfstream GVI will incorporate non-rechargeable lithium batteries, which are novel or unusual design features.

Discussion

We derived the current regulations governing installation of batteries in transport-category airplanes from Civil Air Regulations (CAR) 4b.625(d) as part of the re-codification of CAR 4b that established 14 CFR part 25 in February 1965. We basically reworded the battery requirements, which are currently in § 25.1353(b)(1) through (b)(4), from the CAR requirements. Non-rechargeable lithium batteries are novel and unusual with respect to the state of technology considered when these requirements were codified. These batteries introduce higher energy levels into airplane systems through new chemical compositions in various battery-cell sizes and construction. Interconnection of these cells in battery packs introduces failure modes that require unique design considerations, such as provisions for thermal management.

Recent events involving rechargeable and non-rechargeable lithium batteries prompted the FAA to initiate a broad evaluation of these energy-storage technologies. In January 2013, two independent events involving rechargeable lithium-ion batteries demonstrated unanticipated failure modes. A National Transportation Safety Board (NTSB) letter to the FAA, dated May 22, 2014, which is available at <http://www.nts.gov>, filename A-14-032-036.pdf, describes these events.

On July 12, 2013, an event involving a non-rechargeable lithium battery, in an emergency locator transmitter installation, demonstrated unanticipated failure modes. Air Accident Investigations Branch Bulletin S5/2013 describes this event.

Some other known uses of rechargeable and non-rechargeable lithium batteries on airplanes include:

- Flight deck and avionics systems such as displays, global positioning systems, cockpit voice recorders, flight data recorders, underwater locator beacons, navigation computers,

integrated avionics computers, satellite network and communication systems, communication-management units, and remote-monitor electronic line-replaceable units (LRU);

- Cabin safety, entertainment, and communications equipment, including life rafts, escape slides, seatbelt air bags, cabin management systems, Ethernet switches, routers and media servers, wireless systems, internet and in-flight entertainment systems, satellite televisions, remotes, and handsets;
- Systems in cargo areas including door controls, sensors, video surveillance equipment, and security systems.

Some known potential hazards and failure modes associated with non-rechargeable lithium batteries are:

- **Internal failures**

In general, these batteries are significantly more susceptible to internal failures that can result in self-sustaining increases in temperature and pressure (i.e., thermal runaway) than their nickel-cadmium or lead-acid counterparts. The metallic lithium can ignite, resulting in a self-sustaining fire or explosion.

- **Fast or imbalanced discharging**

Fast discharging or an imbalanced discharge of one cell of a multi-cell battery may create an overheating condition that results in an uncontrollable venting condition, which in turn leads to a thermal event or an explosion.

- **Flammability**

Unlike nickel-cadmium and lead-acid batteries, these batteries use higher energy and current in an electrochemical system that can be configured to maximize energy storage of

lithium. They also use liquid electrolytes that can be extremely flammable. The electrolyte, as well as the electrodes, can serve as a source of fuel for an external fire if the battery casing is breached.

Proposed Special Condition 1 requires that each individual cell within a battery be designed to maintain safe temperatures and pressures. Proposed Special Condition 2 addresses these same issues but for the entire battery. Proposed Special Condition 2 requires the battery be designed to prevent propagation of a thermal event, such as self-sustained, uncontrolled increases in temperature or pressure from one cell to adjacent cells.

Proposed Special Conditions 1 and 2 are intended to ensure that the battery and its cells are designed to eliminate the potential for uncontrolled failures. However, a certain number of failures will occur due to various factors beyond the control of the designer. Therefore, other special conditions are intended to protect the airplane and its occupants if failure occurs.

Proposed Special Conditions 3, 9, and 10 are self-explanatory, and the FAA does not provide further explanation for them at this time.

The FAA proposes Special Condition 4 to make it clear that the flammable-fluid fire-protection requirements of § 25.863 apply to non-rechargeable lithium battery installations. Section 25.863 is applicable to areas of the airplane that could be exposed to flammable fluid leakage from airplane systems. Non-rechargeable lithium batteries contain electrolyte that is a flammable fluid.

Proposed Special Condition 5 requires each non-rechargeable lithium battery installation to not damage surrounding structure or adjacent systems, equipment, or electrical wiring from corrosive fluids or gases that may escape. Proposed Special Condition 6 requires each non-rechargeable lithium battery installation to have provisions to prevent any hazardous effect on

airplane structure or systems caused by the maximum amount of heat the battery installation can generate due to any failure of it or its individual cells. The means of meeting these proposed special conditions may be the same, but they are independent requirements addressing different hazards. Proposed Special Condition 5 addresses corrosive fluids and gases, whereas Proposed Special Condition 6 addresses heat.

Proposed Special Conditions 7 and 8 require non-rechargeable lithium batteries to have automatic means for battery disconnection and control of battery discharge rate due to the fast-acting nature of lithium-battery chemical reactions. Manual intervention would not be timely or effective in mitigating the hazards associated with these batteries.

These special conditions will apply to all non-rechargeable lithium battery installations in lieu of § 25.1353(b)(1) through (b)(4) at Amendment 25-113. Sections 25.1353(b)(1) through (b)(4) at Amendment 25-113 will remain in effect for other battery installations.

These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

Applicability

As discussed above, these special conditions are applicable to the Gulfstream Model GVI airplane. Should Gulfstream apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, these special conditions would apply to that model as well.

Conclusion

This action affects only certain novel or unusual design features on one model of airplane. It is not a rule of general applicability.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

The Proposed Special Conditions

Accordingly, the FAA proposes the following special conditions as part of the type certification basis for Gulfstream Aerospace Corporation Model GVI airplanes.

Non-Rechargeable Lithium Battery Installations

In lieu of § 25.1353(b)(1) through (b)(4) at Amendment 25-113, each non-rechargeable lithium battery installation must:

1. Maintain safe cell temperatures and pressures under all foreseeable operating conditions to prevent fire and explosion.
2. Prevent the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.
3. Not emit explosive or toxic gases, either in normal operation or as a result of its failure, that may accumulate in hazardous quantities within the airplane.
4. Meet the requirements of § 25.863.
5. Not damage surrounding structure or adjacent systems, equipment, or electrical wiring from corrosive fluids or gases that may escape.
6. Have provisions to prevent any hazardous effect on airplane structure or systems caused by the maximum amount of heat it can generate due to any failure of it or its individual cells.

7. Be capable of automatically controlling the discharge rate of each cell to prevent cell imbalance, back-charging, overheating, and uncontrollable temperature and pressure.
8. Have a means to automatically disconnect from its discharging circuit in the event of an over-temperature condition, cell failure or battery failure.
9. Have a failure sensing and warning system to alert the flightcrew if its failure affects safe operation of the airplane.
10. Have a means for the flightcrew or maintenance personnel to determine the battery charge state if the battery's function is required for safe operation of the airplane.

Note 1: A battery system consists of the battery and any protective, monitoring and alerting circuitry or hardware inside or outside of the battery. It also includes vents (where necessary) and packaging. For the purpose of these special conditions, a battery and battery system are referred to as a battery.

Issued in Renton, Washington, on November 11, 2015.

Michael Kaszycki
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service
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